Glass-Forming Metal-Organic Framework

An invited talk

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Invited Talk

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Metal-organic framework (MOF) glasses are a completely new family of melt-quenched (MQ) glasses.[1-3] These glasses have a high potential to be applied in many occasions such as gas separation, gas storage, functional films, etc. However, to realize these applications, several scientific and technological challenges must be addressed. One of those is to understand the formation and recrystallization mechanism of MOF glasses. If a MOF glass can recrystallize, it is then possible to create the microporous structure in the glass, which is of technological interest, e.g., for gas storage application. If the glass does not crystallize, its high optical transparency could be used for optical and photonic applications. Here, we review our recent progress in understanding the behavior of melting, glass formation, relaxation and nano-crystallization of MOFs by taking ZIF-4 and -62 as examples, and thereby illustrate some universal features of MOF glasses. We show that nanocrystallization could occur in ZIF-4 upon heat-treatment between glass transition temperature (T_g) and melting point (T_m), whereas ZIF-62 does not show this behavior. By combining both sub-T_g and above-T_g annealing experiments with structural analysis, we demonstrate our current understanding of the dependence of the glass forming ability of MOFs on their chemical composition and structural heterogeneity. We provide insights into both primary and secondary relaxation behaviours in MOF glasses. Finally, we suggest some possible ways to establish the structural and topological criteria for MOF melting and glass formation.

REFERENCES

1. Bennett, T.D., Tan, J.C., Yue, Y.Z. et al., Hybrid glasses from strong and fragile metal-organic framework liquids, *Nature Commun.* 6, 8079 (2015).
2. Bennett, T.D., Yue, Y.Z., Li, P., et al., Melt-quenched glasses of metal-organic frameworks, *J. Am. Chem. Soc.* 138, 3484- 3492 (2016).
3. Tao, H.Z., Bennett, T.D., Yue, Y.Z., Melt-Quenched Hybrid Glasses from Metal-organic Frameworks, *Adv. Mater.* 29, 1601705 (2017).